

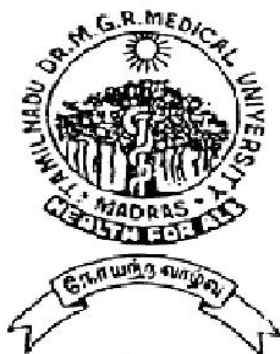
A DISSERTATION ON

COMPARATIVE STUDY OF VISUAL OUTCOME IN

MSICS & PHACOEMULSIFICATION

M.S. DEGREE BRANCH (III)

OPHTHALMOLOGY



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CERTIFICATE

This is to certify that this dissertation entitled “COMPARATIVE STUDY OF VISUAL OUTCOME IN MSICS & PHACOEMULSIFICATION” submitted by DR. V. RAMALAKSHMI to the faculty of Ophthalmology, The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfillment of the requirement of the award of M.S.Degree Branch III (Ophthalmology) is a bonafide research work carried out by her under my direct supervision and guidance.

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DECLARATION

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This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement for the award of M.S., degree (Branch III Ophthalmology) Examination to be held in MARCH 2007.

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ABBREVIATIONS

AC	-	Anterior Chamber
ACIOL	-	Anterior Chamber Intraocular Lens
ATR	-	Against the rule
BSS	-	Balanced Salt Solution
BCVA	-	Best Corrected Visual Acuity
CCC	-	Continuous Curvilinear Capsulorhexis
DM	-	Descemet's Membrane
ECCE	-	Extra Capsular Cataract Extraction
IOL	-	Intraocular Lens
I – A	-	Irrigation – Aspiration
MSICS	-	Manual Small Incision Cataract Surgery
MSISCS	-	Manual Small Incision Sutureless Cataract Surgery
PE	-	Phaco Emulsification
PC	-	Posterior Capsule
PCIOL	-	Posterior Chamber Intraocular Lens
PHACO	-	Phacomulsification
PCR	-	Posterior capsular Rent
SISCS	-	Small incision Sutureless Cataract Surgery
SICS	-	Small incision Cataract Surgery
SIA	-	Surgically induced astigmatism
UCVA	-	Uncorrected Visual Acuity
WTR	-	with the rule

INTRODUCTION

The use of the intraocular lens implant has been the most exciting development in ophthalmology of the last quarter century. So, during the past 2 decades the advances in cataract surgery have produced better visual outcome.

Improvement by means of shortened healing time, a less cumbersome post-operative period, reduced chances of complication and a more predictable outcome. This demand for improvement can be satisfied by universal application of small incision surgery which allows faster and safer healing and reduced suture induced astigmatism. Two principal surgical techniques are used.

1. Phacoemulsification and posterior chamber intraocular lens implantation.
2. Manual Small incision sutureless cataract surgery with posterior chamber intraocular lens implantation.

With an accurate estimation of the power of Intraocular lens, uncomplicated cataract surgery, and an uneventful post-operative period, the implant is capable of providing a visual acuity of 6/6.

Hence, this study is an attempt of comparison of visual outcome in MSICS & Phacoemulsification of 100 cases at Govt.Rajaji Hospital, Madurai in relation to

- (1) Effectiveness which is shown by BCVA
 - (2) Safety in relation to the incidence of intraoperative complications .
- } in Both the
procedures

HISTORICAL REVIEW

Kratz is credited as the first surgeon, to move from the limbus posteriorly to the sclera, increasing appositional surfaces to enhance wound healing and attempt to exert less traction on the cornea, thereby controlling surgically induced astigmatism.

Girard and Hoffman were the first to call the posterior incision a “scleral tunnel incision” and were perhaps the first to make a point of actually entering the anterior chamber from a slightly corneal location. With the availability of small – incision lenses that could be introduced through incisions of 4mm or less, the stage was set for the development of techniques that resulted in the achievement of both relative astigmatism neutrality and self sealing incision.¹¹

In 1989, Shepherd introduced the ‘single horizontal suture’, which was actually a vertical mattress suture, for the closure of 4mm scleral tunnel incisions in phacoemulsification and foldable lens implantation. The achievement of astigmatism neutrality was impressive. Others rapidly recognized that the compressive force of the single horizontal suture was tangential to the limbus and therefore exerted no force on the cornea which would alter its curvature. As a result variations of the Shepherd single stitch

were soon developed for closure of incisions 5-7mm wide, including the Fine infinity suture and Masket's horizontal anchor suture.

In 1989, MCFarland and Ernest introduced an incision architecture that allowed the phacoemulsification and implantation of lenses without the need for suturing. Besides lengthening the scleral tunnel, this incision terminated in a decidedly corneal entrance and the posterior lip of the incision, the so called corneal lip, acted as a one-way valve imparting to this incision its self-sealing characteristics.

Paul Koch described what he called the 'incision funnel' indicating that there were certain characteristics of self sealing incision with respect to length and configuration that imparted not only self-sealability but also astigmatism neutrality to this incision.

SURGICAL PRINCIPLES

Surgical Anatomy of the Limbus:

Limbus is the conjunctivo-corneo-scleral junction. Its width is greatest superiorly, slightly less inferiorly and least horizontally.

The anterior boundary is located at the most anterior part where a limbal based flap can be reflected. Just posterior to this, there is a slightly blue area about 1mm wide that blends with a whitish area also about 1 mm wide. Junction of blue and white area overlies the end of Descemet's membrane (Schwalbe's line). The blue portion overlies clear cornea, whereas the white portion overlies the trabecular meshwork. Anterior border overlies the termination of Bowman's layer, whereas the posterior border overlies the scleral spur.

Pathophysiology of wound Healing

“The Physiology and histology of the healing of a cataract incision should be understood by all who initiate the process”.

Limbal Incision:

Healing of the limbal incision differs from the corneal incision as follows.

1. The occurrence of anterior and posterior triangles due to retraction of the edges of wound was not observed.

2. Since the conjunctival flap prevents epithelium from entering the wound, it is filled by fibrinous exudates derived from the sub conjunctival and episcleral vessels.
3. If the apposition of the lips of the wound is defective the granulation and fibrous tissue may not only fill the hiatus but may grow exuberantly and extend deeply into the wound and may even reach the anterior chamber.¹⁵

Scleral Incision:

Healing of this differs from the corneal and limbal incisions by the following ways.

1. The wound edges do not swell, but rather tend to contract
2. There are no epithelial or endothelial surfaces to bridge the gap.
3. Sclera remains passive. Invasion of histiocytes and vascular elements from the highly vascularized tissue on the side or another namely the episclera and conjunctiva participate in the repair.
4. Scleral incision heal by secondary intention.

Surgical Application:

Pure scleral incision does not heal effectively. However when a scleral incision is used during cataract surgery. It usually does not remain scleral in its entire depth. It is usually beveled or made in planes so that the deeper portion assumes the characteristics of limbal or corneal wound healing.

For eg. a scleral tunnel incision as used for manual phaco with PCIOL implantation has got 3 components. (Self sealing incision)

1.External Scleral Incision

A half thickness perpendicular external scleral groove is fashioned with either Bard parker knife or crescent knife. The groove is located 2.5 to 3 mm from the surgical limbus and could be limbus parallel, linear or frown shaped.

2.Sclerocorneal tunnel

The horizontal tunnel is dissected with a bevel up crescent blade parallel to the sclera, splitting its lamellae. It is extended upto 1 to 1.5mm into clear cornea.

3. Internal Corneal incision

This is created using a sharp 3.2mm angled keratome. The heel of the keratome is raised till the blade becomes parallel to the iris plane and keratome tip creates a dimple in the cornea. Next the keratome is advanced in the same plane till the AC is entered. The incision may be extended to the desired length, which is governed by the optic size of the IOL to be inserted.

The external scleral incision:

- If limbus parallel, curvilinear (smile incision) the potential for wound gape and against the rule astigmatism is more.
- If linear, the risk of wound gape and against the rule astigmatism is reduced.
- If frown shaped, there is maximum stability to the wound and the possibility of against the rule astigmatism is least.

The incision funnel:

The concept of the incisional funnel as introduced by Paul Koch while trying to describe the interaction between astigmatism, incision length and distance from the limbus. The funnel is an imaginary pair of curved lines diverging outward from the limbus, separating as the distance from the

limbus increases. Incision made within this funnel will be for all practical purposes astigmatism neutral.

The internal incision:

It is the actual entry into the eye and therefore has greater influence on astigmatism and wound stability than the external incision. The corneal valve incision confers the self sealing property to the incision. This technique avoids suture induced astigmatism.

FACTORS INFLUENCING POSTOPERATIVE CORNEAL ASTIGMATISM

1.Pre operative factors

a. Age:Physiological corneal astigmatism of with the rule type occurs in young eyes. There is a shift towards against the rule astigmatism with advancing age, so that in patients with senile cataract the astigmatism is usually against the rule.

b) Corneal complications like pterygium, corneal scarring due to injury or previous surgery.

2.Per operative factors:

a) Magnification: Aids in accurate approximation of the wound and so leads to better healing

b)Conjunctival flap: Limbal based flap strongly supports the stromal wound in the critically important early post operative period.

c)Superior rectus bridle suture: Tight suture is associated with “with the rule astigmatism”.

d)Cautery: Excess cautery causes tissue shrinkage resulting in more scarring.

e) Incision:

i) Location:- Anteriorly placed incision steepens and displace the optical axis inferiorly. So incisions made very anteriorly (eg) corneal, result in more post operative astigmatism.

Superolateral incision: As there is an ultimate flattening effect in the meridian of the incision, a temporal incision (along the steep meridian) may reduce the overall astigmatism especially when a scleral tunnel incision is made.

ii) Amplitude/length/extent of incision:

The extent of incision required is smallest in phacoemulsification, larger in SICS and largest in conventional ECCE.

The smaller the amplitude of the incision, the less is the effect on the horizontal meridian. Incision that end at or near the horizontal meridian tend to neutralize some of the changes in the vertical meridian.⁷

iii) Plane of incision:

Single plane incisions

Double plane incisions

Three plane incision

Four plane incision

Three & Four plane incisions produced less astigmatism.

f) Type of surgery

IOL implantation—post operative astigmatism following IOL implantation is largely corneal through decentration of IOL can also contribute a major part. The astigmatism is greater with intended ciliary sulcus fixation than with ‘in the bag’ fixation. (Grover, Bhatnagar,1990)

g) Suturing

If a cataract wound is not self-sealing, then wound closure using suture is required.

Shepherd reported that the use of single horizontal suture to close scleral tunnel incision resulted in less astigmatism

Infinity suture was described by Fine to close a 6.5mm scleral tunnel incision and found it to cause less astigmatism.

Horizontal anchor suture was introduced by Masket as an approach for astigmatically neutral closure of scleral pocket incision. This suture prevented the internal wound gape and reduced the surgically induced astigmatism.

The main advantage of phacoemulsification procedure is reduction in incision size without the need for sutures which results in less SIA and speeds up visual rehabilitation. The length of the incision depends upon the type of the IOL used. Foldable lenses can be inserted with 3 to 4mm incision. Rigid phaco lenses require 5 to 6mm incisions. The former has been shown to produce less astigmatism than the latter. Several studies on small incision surgery have been carried out with reference to postoperative astigmatism.

TEMPORAL INCISION :

- Temporal location of the incision provides several advantages
- Working at the temporal periphery, there is no need to turn the eye down, as when working over the brow, and therefore the bridle sutures, are not necessary.
- With the iris plane parallel to the light of the microscope, the red reflex is enhanced, and there is marked improvement in visualization of intraocular structures.
- This location allows greater access to the incision, than when working over the brow.
- At this location, the lateral canthal angle is directly beneath the incision, the irrigation fluid drains naturally, and therefore, one is rarely working 'under water' as when working over the brow.
- The temporal location is farthest from the visual axis, and thus the endothelial damage, post operatively, is much less than superiorly placed incisions, and – any flattening around the wound is less likely to affect the corneal curvature at the visual axis.
- Incisions at this location, are more stable with respect to ATR drift.
- Very useful in deep seated eyes
- Superior quadrant is available for a future trabeculectomy

- Very convenient to handle the instruments
- When the incision is located superiorly, both gravity and eyelid blink tend to create drag on the incision. With temporally placed incision, these forces are better neutralized because the incision parallel to the vector of the forces.
- At this location, the astigmatism induced, is 'with the rule'. This is advantageous for the large majority of cataract age patient, whose preoperative astigmatism was 'against-the rule'.

SMALL INCISION SUTURELESS CATARACT SURGERY (SISCS-MANUAL PHACO)

In 1983, Gerald T Keener Jr, pioneered the alternative method of small incision cataract extraction which combined the advantages of a standard phacoemulsification with those of a conventional Extracapsular Cataract Extraction.

Advantages of Phacoemulsification were well documented but there were inherent disadvantages like danger of trauma to the endothelium (especially in the early stage of the “learning curve”) and the fact that it was not applicable to all cases, for example, hard nuclei. The relatively high expenses involved and constant break down of the equipment put further constraints on its wide spread use. Conventional extracapsular cataract extraction on the other hand had the disadvantages of large incision, greater post-operative astigmatism, slower rehabilitation. The idea of dividing the nucleus into pieces within the eye and then looping them out thus took root. The early instruments used for nuclear division, though sound in conception and theory were expensive, cumbersome and did not work satisfactorily.

It was then Keener conceived a less complex means of accomplishing the nucleus division. This involved passing a wire loop around the nucleus after first displacing it into the anterior chamber. The loop once around the

nucleus could be constricted, thus dividing the nucleus. Once sectioned, nucleus halves could be removed by sliding them out with a narrow lens loop. This method had the virtue of requiring only simple, readily available instruments. In November 1983, for the first time the lens was removed through a 6.0 mm incision without the use of phaco emulsification.

INSTRUMENTATION

General features of micro-instruments are:

- Length less than 100mm
- Closing pressure should not be too stiff
- Working parts should not open more than 10mm
- The jaws of tying forceps should come together accurately and the edges should be rounded.
- Teeth of micro forceps should be checked for alignment.

Instruments:-

- Lidspeculum
- Forceps
- Needleholders
- Knife handle and blade
- Blade breakers
- Cystitome

- Scissors
- Less Expresser and Vectis
- Infusion –aspiration cannula
- Lens dialing hook
- Nucleus divider
- Lens loop
- Calipers.
- Bevelled up crescent knife.
- Bevelled down keratome 3.2 mm and 5.2 mm.
- Number 15 super blade.
- Muscle hook.

Small Incision Sutureless Cataract Surgery (Manual)

Operative Steps:

1. Under local anaesthesia, conjunctival peritomy is performed over a 3 o'clock hour region of the superior limbus.
2. After light cautery a groove 6.5 mm is fashioned at the posterior aspect of the surgical limbus. A stab wound 90o away from the groove is usually performed. This enables entry of ancillary

instruments if required. A stab wound is then made through the groove, viscoelastic instilled.

3. A capsulotomy is performed. Capsulotomy may either be a can-opener technique or capsulorhexis. If the latter is done care should be taken to make it larger than that employed for phaco emulsification especially superiorly, to allow for luxation of the superior pole into the anterior chamber.
4. Once the capsulotomy is fashioned the wound is enlarged to its full chord length using a keratome.
5. The nucleus is then completely prolapsed into the anterior chamber. This step should be done with care and individual variations according to surgeons comfort can be made. Nucleus prolapse into the anterior chamber is affected using the Sinsky's hook to anchor the nucleus and nudging the superior pole into the anterior chamber with the help of the irrigating cannula. Keener describes the use of the Bishop-Harmon flat tipped irrigating cannula attached to the BSS squeeze bottle. The cannula tip is placed under the nucleus, irrigating all the while and this is gradually advanced to inferior nuclear pole. Then the nucleus is simply lifted into the anterior chamber. Alternative methods

include prolapsing the superior pole into the anterior chamber first and then rotating the rest of the nucleus using a Sinsky's hook or cannula. Use of viscoelastic may further aid in pushing the iris away.¹⁶

6. Nucleus extraction - Modified Blumenthal Technique : In this anterior chamber maintainer is inserted through a separate 1 mm opening at 6 o'clock and a pressurized anterior chamber is maintained through out the procedure. after the capsulotomy, superficial cortex and epinucleus is aspirated with 0.4 mm tip cannula. the minimum possible size hard core nucleus is separated from epinucleus by injecting fluid between the layers of nucleus and it is prolapsed into the anterior chamber. the mini nucleus is engaged in the section, hydrostatic pressure is increased and it is hydroextracted/visco extracted out through the wound. Residual cortex is removed by irrigation / aspiration.

7. PC IOL is placed

if required a single or more 10'0 nylon applied

8. Alternative techniques

- a. Phacosandwich technique
- b. Phacofracture technique
- c. Fish hook technique

PHACOEMULSIFICATION

In 1967, Kelman described a single instrument technique for cataract extraction using ultrasound vibration to remove lens material through a 3mm corneoscleral incision. In this technique nucleus was prolapsed into anterior chamber and later emulsified. Between 1973 and 1979 the results of thousands of Kelman phacoemulsification cases performed by numerous surgeons were reported.¹²

In 1970, Sinskey due to difficulty in delivery of the softer nuclei in to anterior chamber used a 15° Phacotip to sculpt the central nucleus down almost to posterior capsule before removing the peripheral nuclear shell. By performing phacoemulsification posteriorly in the capsular bag and deep in anterior chamber, the damage to endothelial cells was significantly reduced. In 1970, Little and Kratz, popularized two handed phacoemulsification of the nucleus using a spatula as the second instrument. Kratz, used the sideport at 3 O'clock for the second instrument. Little passed second instrument into the anterior chamber directly along the side of the ultrasound tip, after sculpting the nucleus centrally with 45° tip remaining nucleus was tilted and prolapsed out of the superior equator of the capsular bag for further emulsification. Maloney also adopted the technique and taught it to many surgeons.

In 1984, Gimbel developed the Continuous Circular Capsulorhexis (CCC) technique and by 1985 he developed the “divide and conquer” nucleus fracture method of in situ phacoemulsification. In 1986, Gimbel applied the term divide and conquer to in situ phacoemulsification techniques which is derived from Latin “divide et impera”.

Modern day wound construction began with Kratz’s development of scleral tunnel incision (scleral pocket incision) which compared to the limbal incision is made more posterior to the limbus and a scleral tunnel and small corneal edge are created.

Instrumentation :

A thorough understanding of the phacoemulsification is imperative for every phaco surgeon. Each machine has different design feature. However, the basic functions of all machines remain the same. It is critical that every surgeon learns about the machine parameters and their individual effects, how they interrelate and in total how they determine the surgical environment in which the surgery is performed.

Basic Features :

Every Phacoemachine has three basic functions. These are

- i. irrigation
- ii. aspiration and

iii. ultrasonic fragmentation

Correspondingly two hand pieces are used in phacoemulsification

i. the irrigation aspiration hand piece and

ii. phaco or ultrasonic handpiece.

☞ *Irrigation- Aspiration Handpiece :*

The irrigation-aspiration (I-A) hand piece has a silicone sleeve that fits snugly around the aspiration tip. Through this sleeve, irrigation is delivered. The I-A tip differs from the phaco tip in being smooth and rounded with a single aspiration port on the side of the tip and not at the end. The sleeve may be turned to orient the irrigation port in any direction. The irrigation ports in the silicone sleeve should be kept perpendicular to the metallic aspiration port as this helps to direct the infusion fluid along the iris plane. This reduces iris flutter during the surgery.

A variety of I-A tips are available: Straight, 45° or 90° angulation; 0.2mm, 0.3mm, and 0.7mm lumen diameters. Most frequently used is the 0.3mm tip. During use for irrigation aspiration, the foot pedal is on position 2.

☞ Ultrasonic Handpiece :

Phacoemulsification surgery is based on ultrasonic power which is the function of the acoustic vibrator that has been incorporated into the ultrasonic handpiece. Attached to this vibrator is a hollow titanium needle or the phaco tip. The acoustic vibrator is either a magnetostrictive or piezoelectric device that converts electrical energy under the influence of an electrical signal. The acoustic vibrator oscillates longitudinally at a frequency between 30,000-60,000 Hz. This imparts a linear motion to the ultrasonic tip. The stroke amplitude of the linear movement is 3/100 of an inch and the acceleration 80,000-2,40,000G.

Phaco Tip:

The energy so produced along the ultrasonic handpiece is then transmitted onto the phaco tip. The phaco tip is made of titanium and is hollow with the distal opening functioning as the aspiration port. The phaco tip can have various bevel angles ranging from 0° -60° most commonly used are 30° & 45° phaco tips.

Aspiration Pumps :

Depending on the machine, three kinds of pumps are used to control aspiration and produce the negative suction pressure i.e. Vacuum. They are

☞ Peristaltic Pump (constant flow) :

Peristaltic Pump was popularized by heart lung machine. In these pumps a pressure differential is created by compression of the aspiration tubing in a rotatory motion. When the rotational speed is low, vacuum develops only when the aspiration port is occluded. On occlusion, vacuum builds up to preset value in a step ladder pattern. By increasing the rotational speed, as in the newer generation machines, a linear build of vacuum occurs even without occlusion of the tip. It can thus be made to stimulate a venturi or a diaphragmatic pump.

☞ Venturi pump (constant vacuum):

Venturi pump uses compressed gas to create pressure. Vacuum generated is related to gas flow which in turn is regulated by a valve. Vacuum build up occurs linearly in a consistent manner from zero to preset value. The build up is almost instantaneous on pressing the foot pedal.

Due to this there is an increased risk of iris trauma and posterior capsular rents which makes these pumps unsafe, particularly for beginners.

☞ Diaphragmatic pump (Constant vacuum):

Diaphragmatic pump uses a flexible membrane within a cassette to generate vacuum. Build up of vacuum is more linear and reaches the preset level even without occlusion. This makes it unsafe, lens material can be aspirated without having to mechanically approach it.

☞ Foot pedal:

The model of operation in which the instrument is functioning on depressing the foot pedal in a linear manner is shown by the position indicator.

Position 1: Only irrigation solution is flowing.

Position 2: Irrigation and aspiration occur simultaneously.

Position 3: Irrigation and aspiration and fragmentation take place simultaneously.

Mechanism of action of Phaco:

Factors involved include:

- a. A mechanical impact of the tip against the lens.
- b. An acoustical wave transmitted through fluid in front of the tip.
- c. Cavitation: At the cessation of the forward stroke, the tip has imparted forward momentum to the fluid and the lens particles in front of it. On the tip being retracted, the fluid cannot follow thereby created a void in front of the tip. The void is collapsed by the implosion (Cavitation) of the tip thereby creating additional shock waves.
- d. There is an impact of fluid and lens particles being forward in front of the tip.

Considering the mechanism of phaco it is clear that there is attenuation of energy within nuclear material. This reduces the deleterious effects on the corneal endothelium. Therefore posterior chamber phacoemulsification helps maintain safety of the procedure by increasing the working distance from the endothelium.

Phaco parameters:

☞ Ultrasonic power :

The ultrasonic power is usually about 50% to 70%. If the lens is soft, it is decreased to about 30% and if it is hard, power is increased to 80% to 90%.

☞ Effective phaco time :

It is the total phaco time at 100% phaco power. Effective phaco time is very significant as less effective phaco time that indicated proportionately less energy delivered to the eye thereby reducing the side effects of phaco power.

☞ Phacopower :

It is the ability of the phaco hand piece to cut or emulsify cataract. Phacopower is directly related to stroke length, frequency and efficiency of hand piece.

☞ Stroke length :

Stroke length is the distance by which the titanium phacotip moves to and fro. It is most important factor in deciding the phacopower. The stroke length can be altered by changing the phacopower setting of the machine.

☞ Frequency :

Frequency is the number of times the tip moves and it is fixed for a particular phaco handpiece.

It is measured in KHz's. Power variables are adjusted intraoperatively depending on

- Density of nucleus where phacotip engaged
- Amount of tip engaged
- Linear velocity of the tip during emulsification.

While too little a power will fail to cut the nucleus, too much power will cause the nucleus to fly away from the ultrasound tip.

Phacoemulsification

Operative steps

1.Scleral tunnel

First of all the conjunctiva is reflected from the limbus and mild bipolar cautery applied for hemostasis. A caliper is used to mark the length of the incision that is needed for IOL implantation at a suitable distance from the limbus. A preset depth knife (300 μ) is used to make the initial incision into the sclera. A crescent knife is taken and dissection is begun. It is of utmost importance to begin the dissection at the correct depth and then to maintain same depth throughout the length and breadth of the incision.

The dissection is carried forward across the limbus into the clear corneal tissue, again maintaining the same depth of dissection. Once the tunnel is made paracentesis stabs are made at 10'0 clock and 2'0 clock position. A suitable sized (3.2mm) keratome is taken and introduced into the central position of the frown and advances along the dissected tunnel. When the tip of the keratome reaches the end of the tunnel, the tip is advanced into the corneal stroma, again remaining in the same place. At the time intended point of entry into the anterior chamber, the tip of the blade is dipped posteriorly and advanced slowly until the tip of the blade appears inside the chamber. At this point, the direction of the tip of the blade is again turned horizontal and entry completed. Visco Elastic material is injected either through the paracentesis or through scleral tunnel.

2. Continuous Curvilinear capsulorhexis

Using a bent needle of 23-26G a perforation is made in centre of anterior capsule. By extending this with the sharp edge of the needle, a horizontal incision is made. A tip of the needle is now used to redirect the tear in a clockwise direction. This created a flap with a smooth curve at its beginning. The flap is then pulled along in a circular manner by means of gentle traction with a needle tip. If the tear starts to extend peripherally, it is

usually the result of positive vitreous pressure, which can be counteracted by reinflating the anterior with visco elastics. As the flap progresses, large amount of capsular fold will present and must be pushed out of the way, so that one can visualize the exact point at which to place the tip of the needle. When completing the capsulorrhexis one should overlap the tear in such a manner that the last part of the tear joins the first part from the outside towards the center, thus resulting in a continuous edge.

3. Hydrodissection and Hydrodelineation

Hydrodissection:

The infusion fluid is injected exactly between the anterior capsule and the cortex so that the fluid wave dissects all around the capsular bag and separates it . The cortex is completely dissected from the capsule, freeing the entire lens nucleus, epinucleus and the cortex from the capsular bag. This facilitates nucleus rotation and manipulation during phacoemulsification

Hydrodelineation:

The infusion fluid is injected between epinucleus and the nucleus. The fluid wave appears as the golden ring under the surgical microscope. The posterior epinucleus created by hydrodelineation acts as a

cushion safeguarding to a certain extent the posterior capsule during phacoemulsification. Apart from debulking the nucleus, it also enables the more realistic use of linear phaco emulsification.

4. Phacoemulsification by “Divide & Conquer”

Divide and conquer is the most commonly practised technique for emulsification. This technique reduces the phaco power and time thus making the procedure.

Four Quadrant Cracking:

This method of four quadrant cracking is the modification of the technique originally described by John Shepard.

Surgery is initiated by moderate amount of sculpting with some trench digging. Aim is to make the nucleus bear and to create a narrow gulley right down the middle of the cataract. The trench should be as deep as possible and about two phacotips wide. After the first trench is made the nucleus is rotated through 90°s clockwise with a nucleus rotator/spatula inserted through side port incision. Another trench is made in the inferior nucleus similar to the first trench as deep as possible, beginning the process of quartering the nucleus. After the second trench is dug the nucleus is rotated clockwise another 90°s and the third trench is made. The nucleus is rotated through 90°s once more and the fourth trench is made. It is

important that the trenches are of adequate depth and width as this ensures an easy cracking of the nucleus. After trenching of the nucleus the nucleus cracked into four fragments. The first fragment is engaged and emulsified by phaco tip followed by other three fragments. After the removal of the nucleus, the epinucleus and cortex are removed.

5. Extension of Phaco Incision

The extension is done using a blunt tipped extension keratome. The size of the keratome should equal the diameter of IOL optic that needs to be implanted through it or required size for the foldable lens design.

6. Closing of phaco Incision

The capsular bag is inflated using viscoelastic, followed by implantation of IOL. The viscoelastic is removed from the chamber and in turn inflated with the irrigating fluid. The high pressure inside the chamber forces the two lips of internal opening against each other and closes them. The integrity of the incision should be checked by depressing the posterior lip of the incision. If the incision is leaking, hydration of corneal stroma may be tried at the extreme ends of the incision. The corneal edema pulls the tissue against each other and helps in a leak proof closure.

In case the incision still leaks, a single, horizontal 10-0 nylon or 10-0 vicryl should close the wound.

Comparison of Merits & Demerits of MSICS With Phaco

MSICS		PHACO
1. Machine independent	-	Machine dependent
2. Economical and High Volume surgery	-	Costly
3. Easy to learn	-	Needs proper training
4. Can do in any type of cataract surgery	-	-----
5. Good wound stability	-	Better wound stability
6. Less chances of shallow AC	-	Very minimal chances of shallow AC
7. Can do in small pupil and hazy cornea	-	_____
8. Less induced astigmatism	-	Very minimal induced astigmatism
9. Increased patient comfort & early visual rehabilitation.	-	Very comfortable to patient & very early visual rehabilitation
10. _____	-	Can be done under topical anesthesia

AIMS AND OBJECTIVES

The aim is to compare the two cataract extraction procedures performed in 100 patients at Govt. Rajaji hospital, Madurai during the year 2005 January to 2005 December.

1. Manual Small incision sutureless cataract surgery with
PCIOL implantation (MSISCS /PC-IOL)
2. Phaco Emulsification with PC IOL implantation
(PHACO/PC-IOL)

In terms of

- a) Visual acuity
- b) Induced astigmatism
- c) Incidence of intra-operative complications.

REVIEW OF LITERATURE

The following per-operative and post-operative parameters received our attention in this study.

- Visual acuity
- Astigmatism
- Intra Operative Complications.

Our literature search led us through a maze of studies, reports, in textbooks and journals and the appropriate literature are presented here.

I. International Ophthalmology Clinics, Spring 1994, Vol No 2

Recommendations,

☞ Incisions 6.5 – 7.5mm will be used for implantation of 6-7mm lenses drift to 1-2 D ATR. These incisions may be closed with a running shoelace suture, interrupted sutures, or a continuous horizontal sutures. Incisions 5-5.5mm wide are used to insert 5-6mm optic lenses after PE. A straight or frown incision is formed, in sclera 2-3mm behind conjunctival insertion. Incision of this size can be closed with a running or more simply a simple horizontal 10/0 nylon sutures. This incision causes less induced astigmatism.²

II - International ophthalmology clinics, Spring 1994,

- Incisions of 4 mm or less are used for insertion of foldable IOLs. The incision is often left unsutured or closed with suture, can be expected to drift 0.25 – 0.5 D ATR. Configuration of incision may also influence wound stability and eventual ATR drift.
- A straight or frown incision appears to induce less ATR than the traditional curved incision parallel to the limbus.

III - Steinert, Roger F et al, Ophthalmology Vol. 98(4), 1991 April, 417.

A study designed to compare the amount of induced cylinder and axis shift in 4 types of 4.0 mm cataract incisions, 372 patients, each of whom had 4.0 mm incision were divided into 4 groups.¹

Group 1 Consisted of patients who had a two step scleral tunnel incision closed with X stitch suture using 4.0 nylon

Group 2 Consisted patients who underwent two step scleral tunnel incision, closed with a 10.0 nylon horizontal mattress sutures.

Group 3 Composed of patients who received a three step scleral tunnel incision with internal corneal lip that was closed with 10.0 nylon mattress sutures.

Group 4 Consists of patients with a three step scleral tunnel incision, with an internal corneal lip that was not sutured.

Study found no difference in induced cylinder between incisions either with or without internal corneal lip in patients, who received a 4.0 mm scleral tunnel incision that was closed with a horizontal mattress stitch (gr. 2 + 3). Patients with an internal corneal lip and sutureless closure (gr 4) also had a comparable amount of induced cylinder. Patients whose wound was closed with X stitches

(gr.1) experienced WTR cylinder. Several months there was no difference between all the 4 groups.

IV Linda Civerchia Balent, Kalpana Narendrum, Surekha Patel, Sumit Kar, David A. Patterson. High volume sutureless Intraocular Lens Surgery in a Rural Eye camp in India. Ophthalmic surgery and Lasers 2001 ; 32 : 6 : 446 – 455.

The objective of this study was to describe the use of small incision sutureless cataract surgery (SISCS) that permits high volume, high quality and low-cost surgery. 60% attained uncorrected vision of 6/24 or better. There was little difference in visual results or complication rates among the three techniques – SISCS, phacoemulsification and standard extracapsular cataract extraction technique. SISCS enables experienced surgeons to perform the technique in 3.0 to 4.2 minutes.²⁰

V Mihir Kothari, Ravi Thomas, Rajul Parikh, Andrew Braganza, Thomas Kuriakose, Jayaprakash Muliyl. The incidence of vitreous loss and visual outcome in patients undergoing cataract surgery in a Teaching Hospital. Indian J Ophthalmol 2003 ; 51 : 45-52.

Vitreous loss occurred in 8.3% for ECCE, 8.1% for Blumenthal Technique and 5% with phacoemulsification. Vision > 6/18 was achieved in 85% of cases and 95% of controls.⁶

VI James Paul Guzek, Andrea Ching. Small Incision manual extracapsular cataract surgery in Ghana, West Africa. J Cataract Refract Surg 2003 ; 29 : 57 – 64.

Self sealing wound were achieved in 64.5% of cases in small incision ECCE group. Vitreous loss occurred in 3% of eyes. More than 90% of eyes achieved a final best corrected visual acuity of at least 20/60. Eye in small incision group had faster visual recovery, lower incidence of fibrinous iritis and were more likely to have round pupils than eyes in the control group. The main complication of small incision surgery was moderate corneal oedema, which persisted until at least the I week visit in 14 eyes (7%).¹⁷

VII P.M Gogate, M Deshpande, RP Wormald, R Deshpande, S R Kulkarni. Extracapsular Cataract surgery compared with manual small incision cataract surgery in community eye care setting in Western India : a randomized controlled trial. Br J Ophthalmol 2003 ; 87 : 667 – 672.

The aim of this study was to study “Manual Small Incision Cataract Surgery (MSICS)”for the rehabilitation of cataract visually impaired and blind patients in community based, high volume, eye hospital setting ; to

compare the safety and effectiveness of MSICS with conventional extracapsular cataract surgery (ECCE). 37.3% of ECCE group and 47.9% of MSICS group had uncorrected visual acuity of 6/18 or better after 6 weeks of follow up. 86.7% of ECCE group and 89.8% of MSICS group had corrected post operative vision of 6/18 or better. MSICS and ECCE are both safe and effective techniques for treatment of cataract patients in community eye care settings. MSICS needs similar equipment to ECCE, but gives better uncorrected vision.⁵

VIII Bradley R. Straatsma, Kenneth T. Meyer, James V. Bastek.
Posterior Chamber Intraocular Lens Implantation by Ophthalmology
Residence : A prospective study of cataract surgery ophthalmology
1983 : 90 : 327-335.

This study group evaluated ECCE – posterior chamber Intraocular lens performed by 8 senior ophthalmology residents with faculty supervision and five faculty ophthalmologists experienced in Intraocular lens surgery. Excluding cases with pre-existing eye disease, resident surgery achieved 20/40 or better final visual acuity in 95% of eyes ; faculty surgery achieved 20/40 or better in 96%.

MATERIALS AND METHODS

Our study was a randomized prospective study of comparing the two cataract extraction procedures

(MSICS/PC-IOL & Phaco Emulsification /PC-IOL)

In terms of Visual acuity, Induced astigmatism, Incidence of intra-operative complications at Dept.of Ophthalmology, Govt.Rajaji Hospital, Madurai.

☞ About 100 patients with cataract were randomly selected between the age group of 35-75 years of age, and they were randomly assigned to undergo any of the two procedures.

☞ Two experienced surgeon who were well versed with the two cataract extraction procedures performed the surgeries. In phaco, superotemporal or temporal incisions were made.

☞ Randomization (type of surgery to be done) was released on the table and the surgeon did the mentioned procedure and documented the intra-operative results.

☞ Inclusion Criteria

- All patients were between 35 -70 years
- Normal Anterior chamber depth
- Adequate pupillary dilatation (at least 5 mm)

- Grade 1-3 nuclear sclerosis (EMMERY'S CLASSIFICATION) with or without posterior sub-capsular opacification.

☞ Exclusion Criteria

- Grade IV/ Brown cataracts
 - Traumatic cataract
 - Subluxated cataract
 - Corneal disorders
 - Complicated cataract
 - Pseudo –Exfoliation
 - Mature cataract
- } Included for MSICS
and not for PHACO

☞ Evaluation

❖ Preoperative

The selected patients underwent a thorough preoperative examination which included

- i) Uncorrected visual acuity (UCVA)
- ii) Best corrected visual acuity (BCVA)
- iv) A Scan and K Reading (Keratometry)

❖ Postoperative

40th postoperative day, the following parameters were examined:

- i)Uncorrected visual acuity (UCVA)
- ii) Best corrected visual acuity (BCVA)
- iii) Keratometry

At the end of 6 months the following parameters were examined:

- i) UCVA
- ii) BCVA
- iii) Keratometry – (K Reading)

☞ Visual acuity

We used the Snellen's Chart to record visual acuity in all our patients.

☞ Keratometry

Reichert's Keratometer: (Bausch & Lomb's kertometer now manufactured by Reichert) was used in this study. The main elements are,

1. Illuminated mires
2. telescope to magnify the reflected image.
3. a doubling prism that makes it possible to accurately measure the size of a constantly moving mire image.

Axis measurement:

Keratometer tube is rotated until the left and focussing mires '+' signs are aligned.

Curvature measurement:

Left measuring drum is used to superimpose '+' signs for horizontal meridian, use right measuring drum is used to superimpose '—' Sign for vertical meridian.

RESULTS

The main aim of our study is to compare the

- Visual acuity outcome
- Surgically induced astigmatism
- Intraoperative complications

Between Manual Phaco & Phaco Emulsification

Types of Surgery:

A total of 100 patients were selected for the study of which **40** patients underwent phaco Emulsification, **60** patients underwent MSISCS.

Table – 1

Types of Surgery

Surgery	Frequency	Percentage (%)
Phaco	40	40
Manual Phaco	60	60
Total	100	100

AGE INCIDENCE

In our study the youngest patient was 40 years, the oldest was 72. Majority of patients in the Phaco group were in the less than 50 Age group category and majority of patients in the Manual Phaco group were in the 51-60 Age group. This distribution was due to randomisation.

Table – 2

Age incidence

Age (in years)	Phaco	Manual Phaco
<50	25 (62.5%)	10 (16.7%)
51-60	10 (25%)	30 (50%)
>61	5(12.5%)	20(33.3%)
Total	40(100%)	60(100%)

Sex Incidence:-

The total male and female ratio was 45:55

In phaco sex ratio is 37.5 : 62.5

In manual phaco sex ratio is 50 : 50

Table – 3

Sex incidence

Sex	Phaco	Manual Phaco
Male	15 (37.5%)	30 (50%)
Female	25 (62.5%)	30 (50%)
Total	40 (100%)	60 (100%)

Visual Acuity (Evaluation was done using the Snellen's chart)

- At 40 day postoperative visit

In the phaco group all 36 patients (100%) showed visual improvement .

In the manual phaco group 56 patients (93.33%) improved.

Table – 4

Change in visual Acuity - 40th day

Sex	Phaco	Manual Phaco
Improved	100%	93.33%
Stayed same	-	-
Deteriorated	-	6.67 %

Table -5

Visual Acuity status - 40th day

VISION	PHACO	MSICS
6/6 – 6/9	30 (83.33%)	46 (76.66%)
6/12 – 6/18	2(5.55%)	10 (16.66%)
6/24 – 6/36	2(5.55%)	-
6/60	2(5.55%)	2 (3.33%)
< 6/60	-	2 (3.33%)

- At the 6 months postoperative visit:

In the phaco group all 20 patients (100%) improved

In the manual phaco group 30 patients (99.75%)

improved, while vision of 2 patients (6.7%) deteriorated.

Table – 6
Change in visual Acuity 6th month

Vision	Phaco	Manual Phaco
Improved	100%	93.75%
Stayed Same	-	-
Deteriorated	-	6.25%

Table – 7
Visual acuity status – 6th month

VISION	PHACO	MSICS
6/6 – 6/9	17 (85%)	27(84..4%)
6/12 – 6/18	2(10%)	3(9.4%)
6/24 – 6/36	1 (5%)	---
6/60	----	---
<6/60	----	2 (6.2%)

The visual acuity outcome in the two surgical procedures were comparably the same.

Astigmatism

Surgically induced astigmatism was calculated using the kertometry value and the following comparisons were made.

- 40th day postoperative visit: Surgically Induced

Astigmatism

Type of Surgery	No.of patients	Mean	Standard Deviation	Minimum	Maximum
Phaco	36	1.100476	0.7598058	0.13	3.13
Man.Phaco	56	1.124333	0.9424644	0.13	4.2

The above table shows that induced astigmatism measured in dioptres is little higher in MSCIS group, as compared to the phaco.

At 6 months postoperative visit: Surgically Induced astigmatism

Type of Surgery	No.of patients	Mean	Standard Deviation	Minimum	Maximum
Phaco	20	1.1125	0.6638147	0.45	2.58
Man.Phaco	30	1.333125	0.8654457	0.13	3.22

The above table shows that as in the 40 postoperative day, mean induced astigmatism is higher in the MSICS group as compared to the phaco.

Intra operative Complications

Type of surgery	Phaco	Manual Phaco
Complications	4.4%	10%

In our study in the phaco group 2 patients (4.4%) had intraoperative complications which were corneal phaco burn, posterior capsular rupture without vitreous loss. In the manual phaco group 6 patients (10%) had complications like posterior capsular rupture without vitreous loss, zonular dialysis & corneal oedema.

All patients in the phaco group and manual phaco had IOL implanted.

DISCUSSION

We had 100 randomly selected patients for our study, who underwent either of the two cataract surgical procedures (MSICS & PHACO). The type of surgery was decided by randomization.

At the 40th day post-operative follow up visit 96 out of 100 patients reported back to the hospital. But at 6th month postoperative visit of only 52 of the 100 patients visited the hospital.

Though the patients were counselled at the time of discharge and when they visited us at the 40th postoperative day, the poor turnout at the 6th month postoperative visit could not be explained. This did affect our aim to have a reasonable sample size/ number of patients and hence a more accurate outcome assessment.

Type of surgery

This was decided by randomization. We had selected two experienced surgeons well versed with the two surgical procedures.

Out of the 100 patients, by randomization, 40 patients (40%) underwent phacoemulsification, 60 patients (60%) underwent Manual Phaco (SISCS).

Age incidence

The youngest was 40 years old and the oldest was 72 years old. The phaco group had the most number of younger patients, 25 (62.5%) in the ≤ 50 years category, the Manual Phaco group had the most number of middle aged patients, (50%) in the 51-60 years category.

Sex Incidence

There was a slight preponderance of female over male patients, 45(45%) Vs 55(55%)

Visual Acuity

As reported by Zhaou, Leon Ellwyn et al. In AJO 2998 Vol. 126: 15, visual functioning and quality of life scores were closely correlated with visual acuity in operated eyes.¹⁹ All our patients had good visual outcomes. At the 40th postoperative day 92 out of 96 had visual acuity $\geq 6/18$. While the other 4 patients had deteriorated vision compared to the preoperative vision At the 6 month postoperative visit 50 out of 52 patients had visual acuity $\geq 6/12$ while the other 2 patients had deteriorated vision .

At the 40th postoperative day visit

In the manual phaco group 56 out of 60 (93.33%) showed improvement in visual acuity. 46 patients (76.66%) had visual acuity 6/9

or better. 10 patients (16.66%) were in the 6/12 category, 2 patients (3.33%) had 6/60 vision, 2 patients (3.33%) were in the 5/60 category. In the phaco group all the 36/36(100%) showed improvement, 30 patients (83.33%) had a visual acuity of 6/9 or better. 2 patients (5.55%) were in the 6/12 category, 2 patients (5.55%) were in the 6/18 category, while 2 patients (5.55%) had 6/36 visual acuity.

At the 6 month follow up visit

In the manual phaco group 30/32 patients (93.75%) showed improvement visual acuity, 30 patients were in the 6/9 to 6/12 category. While 2 patients had 5/60 vision .

In the phaco group 20/20 patients (100%) showed improvement in visual acuity, 17 patients (85%) were in the 6/9 or better category, 2 patients had 6/12 (10%), 1 patient (5%) was in the 6/36 category. The visual acuity outcome in the two surgical procedures were comparably the same.

Induced Astigmatism

Review of literature revealed the following facts with regard to astigmatism. If the incision is located superiorly, with the rule (WTR) astigmatism is produced. Over several years, however progressive corneal flattening is produced in the vertical meridian and the net result is against the rule astigmatism(ATR). With the supero temporal and temporal

incisions the surgically induced astigmatism is less compared to the superior incision.

In the manual phaco group the mean induced Astigmatism was 1.124333 and 1.333125, in the phaco it was 1.100476 and 1.1125 in the 40th day and 6 months post operative visit respectively, which is comparatively slightly less in phaco group.

Intraoperative complications

In a total number of 100 patients on whom surgery was performed, 92 patients (92%) had no complications, 8 patients (8%) had complications.

♥ In the phaco group 2 cases (4.4%) out of 40 patients had complications.

- 1 patient was with grade III – IV Nuclear Sclerosis and increased in phaco II time and hence increased exposure to thermal energy which led to corneal damage.
- 1 patient had posterior capsular rent with minimal vitreous loss. The rent was superiorly extending for 2 0' clock hours. For that case anterior vitrectomy was done and IOL placed in the sulcus.

In the Manual phaco group 6 patients (10%) out of the 60 patients had complications.

- 2 patients had posterior capsular rupture without vitreous loss
- 1 patient had Zonular dialysis with out vitreous loss.
- 3 patients had corneal oedema.

So, in our study the phaco emulsification produced less complications than the MSICS. The less incidence of intraoperative complications depends upon the selection of cases, the selection of the technique and the surgical skill of the surgeon in conquering the technique and the machine.

SUMMARY

- The aim of our study was to evaluate and compare the visual outcome in the two cataract procedures (manual phaco and instrumental phaco)

- Efficacy was determined by evaluating visual acuity outcome and surgically induced astigmatism.Safety was determined by assessing the incidence of intra- operative complications

- 100 patients were selected for our study between the age groups of 35 – 75 years, 45 were males and 55 were females.

- Phaco was performed in 40 patients (40%),and Manual phaco in 60 patients (60%)

- Visual acuity outcome was comparable between the two procedures, 100% patients showed improved visual acuity in the phaco group, while, 93.75% showed improvement in the manual phaco group

- Phaco group produced less mean induced astigmatism compared to MSICS. Surgically induced astigmatism in the manual phaco and phaco groups increased marginally after 6 months.

- Intra-operative complications were less in the phaco group (4.4%) when compared to the manual phaco (10%).This may be

attributed to the proper screening and selection of cases, the selection of the technique and the skill of the surgeon in conquering the technique and the machine .

CONCLUSION

- ♥ In our study the visual outcomes were comparably the same in the 2 cataract procedures (MSICS & PHACO)
- ♥ Phaco group produced slightly less mean induced astigmatism compared to the manual phaco
- ♥ The instrumental phaco group produced less serious complications than manual phaco.
- ♥ In Government institutions like ours (Government Rajaji Hospital), where there is a large group of population to be catered, we have to consider the economic constraints also. Now with more training facilities, experienced surgeons, and with the availability of sophisticated instruments Phacoemulsification is done for selected cases only with less complications.

In future, both manual and Instrumental phaco can be applied equally for all set up. This may also reduce the number of complication and follow up visits.

Hence both are equally safe and effective in skilled hands to acquire better visual outcome.

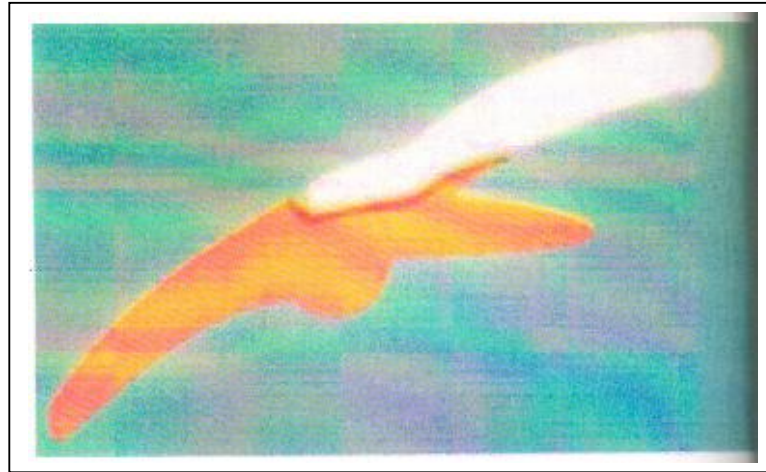
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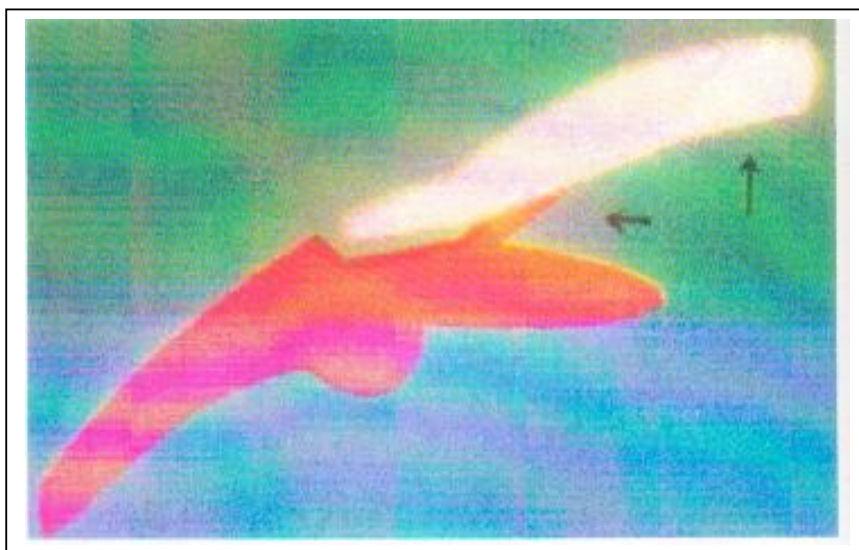
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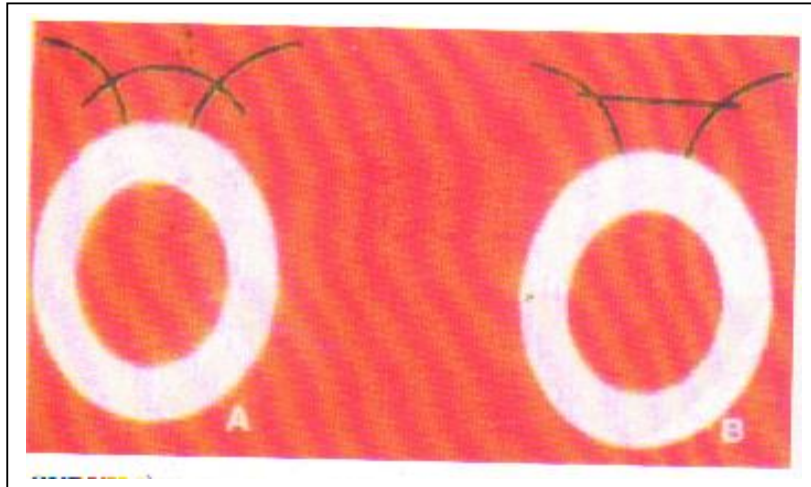
CORNEAL LIP INCISION



AS THE INTRACORNEAL PRESSURE INCREASES THE INTERNAL CORNEAL FLAP IS FORCED UP AGAINST THE INTRACORNEAL PORTION OF THE INCISION, SEALING THE WOUND AND MAKING IT WATERTIGHT WITHOUT SUTURES.

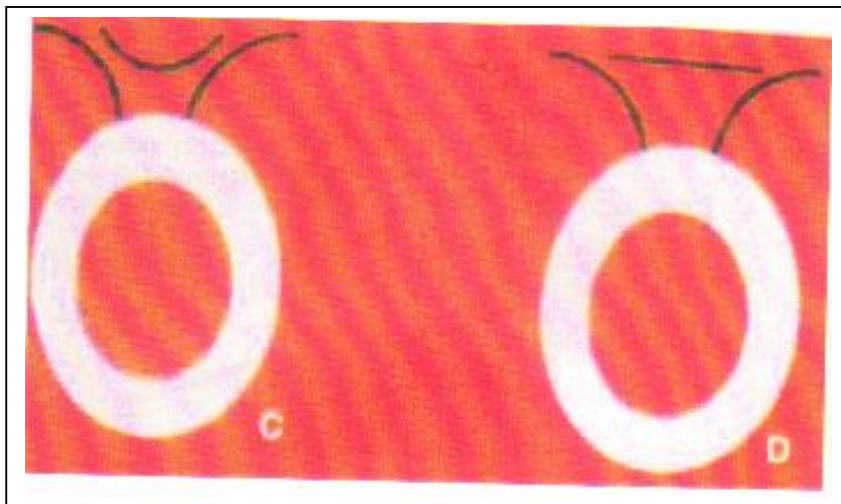


THE INCISIONAL FUNNEL



A- CURVILINEAR INCISION MADE PARALLEL TO THE LIMBUS
CROSSES OUT OF THE INCISIONAL FUNNEL – UNSTABLE

B - THE STRAIGHT INCISION – FALLS OUT SIDE THE FUNNEL
STABLE THAN A



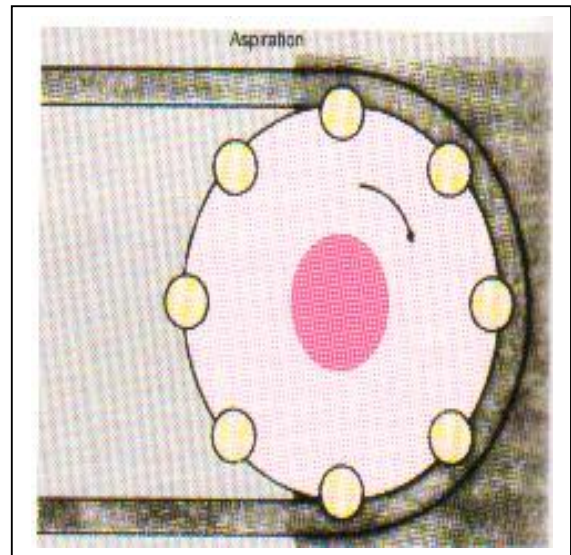
C – FROWN / CHEVRON INCISION – LIE ENTIRELY WITHIN THE
FUNNEL – MORE STABLE

D – LINEAR INCISION AWAY FROM THE LIMBUS – MORE
STABLE BUT HAMPERS THE VIEW.

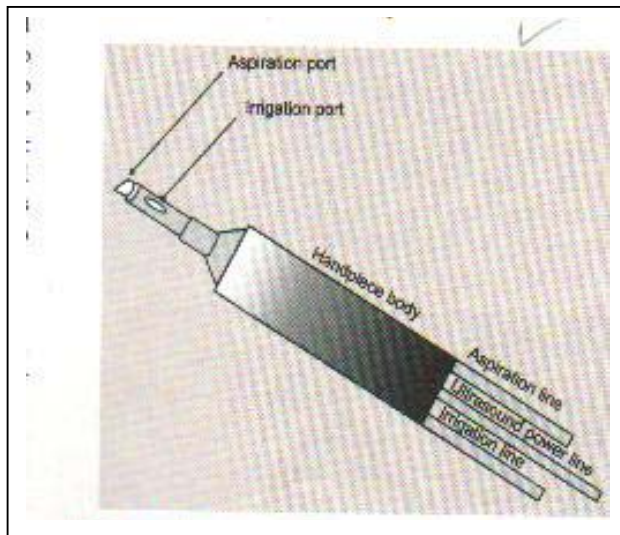
PHACO MACHINE



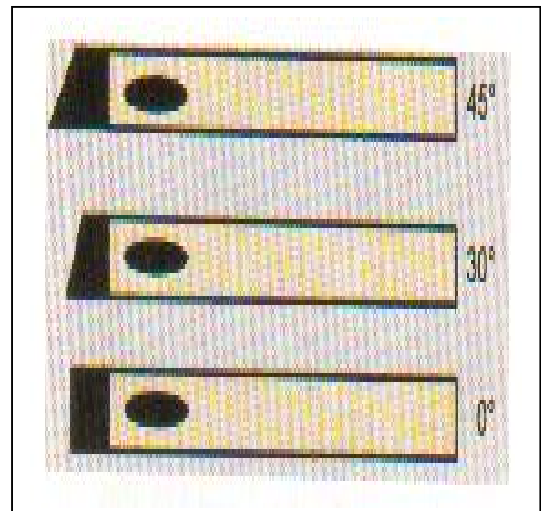
PERISTALTIC PUMP



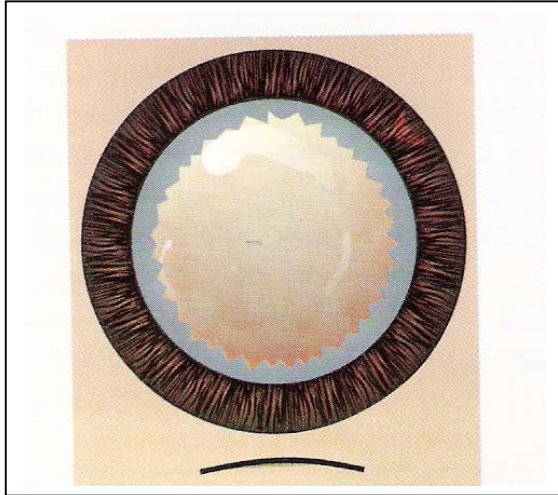
HAND PIECE



PHACO TIPS

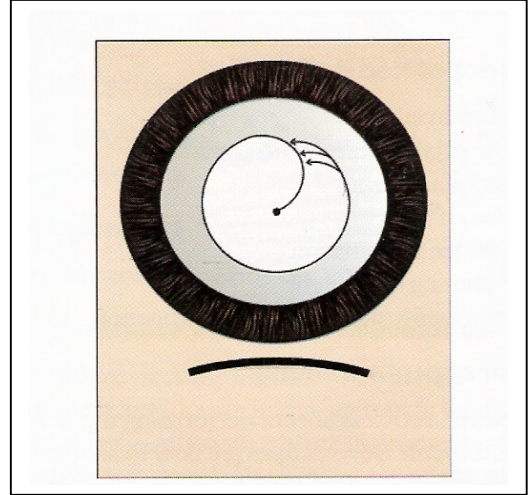


CANOPENER CAPSULOTOMY

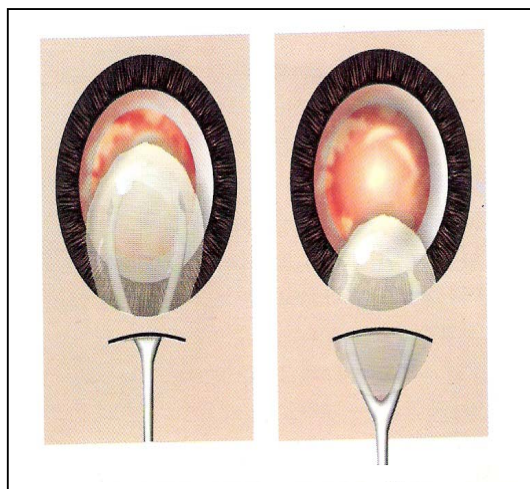


COMPLETION OF RHEXIS

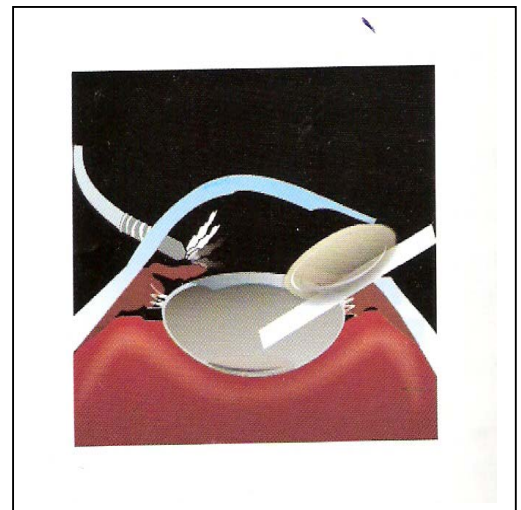
FROM OUTSIDE IN (CCC)



NUCLEUS EXTRACTION WITH
AN IRRIGATING VECTIS



MODIFIED BLUEMENTHAL
TECHNIQUE



MASTER CHART

S.No	Name	Age	Sex	I.P.No	Eye R / L	Preoperative Vision	Types of Surgery	Intraoperative complication	Postoperative Vision (BCVA)	
									40 th day	6 th Month
1	Ramuthai	60	F	137980	R	HM	MSICS	-	6/6	6/6
2	Kulaselvam	50	M	131887	L	3/60	MSICS	-	6/9	6/9
3	Govindan	60	M	131776	L	2/60	MSICS	-	6/9	-
4	Janakiammal	52	F	131790	R	6/60	PHACO	-	6/12 6/9	
5	Pitchiammal	62	F	131671	L	6/60	MSICS	-	6/9 6/9	
6	Subbiah	61	M	131678	R	3/60	PHACO	-	6/6 6/9	
7	Veerammal	65	F	131592	R	2/60	MSICS	-	6/6 6/6	
8	Meenakshi	60	F	131800	R	HM	MSICS	-	6/6 -	
9	Karuppayee	55	F	131840	L	PL	MSICS	-	6/9 6/9	
10	Kanniammal	62	F	129756	L	HM	PHACO	-	6/36	-
11	Irulayee	50	F	131953	R	6/60	PHACO	-	6/36 6/12	
12	Alagapillai	55	F	131878	L	3/60	MSICS	-	6/9	6/9
13	Nagalakshmi	62	F	131991	R	4/60	MSICS	-	6/9	6/6
14	Samsulayee	60	F	129606	L	1/60	PHACO	-	6/12	6/12

15	Sivanandi	60	M	124636	L	6/36	MSICS	Corneal Oedema	6/60	6/36
16	Rajathi	72	F	131961	L	6/60	MSICS	-	6/9	-
17	Mariammal	51	F	131953	R	3/60	PHACO	-	6/18	6/12
18	Pappayee	64	F	131960	R	4/60	MSICS	-	6/9	6/9
19	Raman	56	M	131888	L	2/60	MSICS	-	6/9	6/9
20	Devan	54	M	131461	R	CFCF	PHACO	-	6/18	6/12
21	Raziya Begam	46	F	132000	L	3/60	MSICS	-	6/9	6/9
22	Madasamy	42	M	132006	L	4/60	PHACO	-	6/9	-
23	Karuppan	49	M	132015	R	HM	PHACO	-	6/9	-
24	Kuzhthai	55	M	132010	L	5/60	MSICS	-	6/6	-
25	Sithan	60	M	134100	R	3/60	MSICS	-	6/6	-
26	Arasan	61	M	134000	L	5/60	MSICS	-	6/12	6/9
27	Madavelan	55	M	132255	R	CFCF	MSICS	-	6/9	6/9
28	Irulappan	48	F	132455	L	1/60	PHACO	-	6/6	-
29	Narayanan	47	M	132460	R	3/60	MSICS	-	6/9	6/6
30	Otchammal	41	F	132468	L	5/60	MSICS	-	6/9	6/6
31	Moorthy	55	M	132469	R	6/60	PHACO	-	6/6	-
32	Ganapathyammal	60	F	132510	R	5/60	MSICS	PCR with out Vitreous Loss	6/24	6/18
33	George	62	M	132500	L	4/60	PHACO	-	6/6	-
34	Solai	61	M	132516	R	HM	MSICS	-	6/9	6/9
35	Krishnan	49	M	132518	R	3/60	PHACO	-	6/6	-
36	Mohd Anifa	47	M	132542	L	2/60	MSICS	-	6/12	6/9

37	Radakrishnan	60	M	132300	R	3/60	MSICS	-	6/12	6/9
38	Meena	65	F	132511	R	6/36	PHACO	-	6/9	6/6
39	Saravanan	55	M	132304	L	6/60	MSICS	-	6/6	6/6
40	Sankaran	60	M	132308	L	4/60	MSICS	-	6/6	-
41	Solamalai	60	M	132550	L	3/60	MSICS	-	6/9	6/9
42	Sabarimalai	62	M	132580	R	4/60	MSICS	-	6/9	6/9
43	Sami	65	M	132582	L	2/60	MSICS	-	6/6	-
44	Veeranan	60	M	132581	R	5/60	MSICS	-	6/9	6/6
45	Umadevi	48	F	132590	L	HM	PHACO	PCR with Vitreous Loss	6/36	6/36
46	Uma	46	F	132594	L	2/60	MSICS	-	6/9	-
47	Sudhakar	55	M	132598	R	3/60	PHACO	-	6/9	6/9
48	Sangili	46	M	132592	L	6/60	PHACO	-	6/6	-
49	Pappa	48	F	132599	R	2/60	MSICS	-	6/6	-
50	Sudarmalai	50	F	132600	L	5/60	MSICS	PCR with out Vitreous Loss	6/36	6/24
51	Arumugam	55	M	132610	R	2/60	PHACO	-	6/9	6/9
52	Sivagami	55	F	132615	L	6/60	PHACO	-	6/9	6/9
53	Rani	60	F	132670	R	6/60	PHACO	-	6/9	6/9
54	Sankari	62	F	132617	L	3/60	PHACO	-	6/6	-
55	Santha	68	F	132619	R	6/36	MSICS	Zonular Dialysis with out Vitreous Loss	6/60	6/60

56	Saraswathi	54	F	132301	L	5/60	PHACO	-	6/6	6/6
57	Solaipandi	54	F	132630	R	3/60	MSICS	-	6/12	6/9
58	Santhanamari	49	F	132635	L	2/60	PHACO	-	6/9	6/9
59	Savithiri	48	F	132636	R	2/60	MSICS	-	6/6	6/6
60	Samiappan	45	M	132645	L	2/60	PHACO	-	6/9	6/9
61	Thailammal	51	F	132650	L	2/60	PHACO	-	6/9	6/9
62	Ulagammal	55	F	132655	R	5/60	MSICS	-	6/9	-
63	Janagathan	56	M	132658	L	2/60	MSICS	-	6/12	-
64	Subramani	42	M	132659	R	5/60	PHACO	-	6/6	-
65	Manikandan	49	M	132700	L	2/60	MSICS	-	6/12	-
66	Lakshmi	49	F	132705	R	5/60	PHACO	-	6/6	6/6
67	Meenakumari	52	F	132710	L	2/60	MSICS	-	6/9	-
68	Petchi	50	F	132600	R	HM	MSICS	-	6/6	-
69	Muthammal	56	F	132703	R	2/60	PHACO	-	6/6	6/6
70	Muthu	49	M	132720	L	5/60	PHACO	Phaco burn and Corneal damage	6/36	6/36
71	Malaimmal	57	F	132725	R	2/60	PHACO	-	6/9	6/9
72	Devaraj	49	M	132726	R	5/60	PHACO	-	6/9	-
73	Sudarmalai	64	F	132729	L	2/60	MSICS	-	6/6	6/6
74	Sundram	48	M	132740	R	5/60	MSICS	-	6/12	-
75	Somu	45	M	132750	L	2/60	PHACO	-	-	-
76	Veera Kumar	60	M	132753	L	3/60	MSICS	-	6/12	-
77	Kali	55	M	132758	R	5/60	PHACO	-	6/9	-

78	Mari	56	F	132770	L	2/60	PHACO	-	6/9	-
79	Pattu	62	F	132800	R	HM	PHACO	-	-	-
80	Poovayee	64	F	132790	L	3/60	PHACO	-	-	-
81	Ragu	46	M	132805	L	3/60	MSICS	-	6/9	-
82	Rajammal	49	F	132805	L	3/60	PHACO	-	6/9	-
83	Pattukani	64	F	132808	R	2/60	PHACO	-	6/6	6/6
84	Muthurani	68	F	132810	L	5/60	MSICS	-	6/6	-
85	Sokki	48	F	132850	L	2/60	PHACO	-	6/9	6/9
86	Balammal	50	F	132849	R	5/60	PHACO	-	6/9	6/9
87	Kathir	50	M	132860	L	HM	MSICS	-	6/9	-
88	Balanayaki	47	F	132865	R	6/60	MSICS	corneal oedema	5/60	6/36
89	Maniammal	50	F	132869	L	5/60	PHACO	-	-	-
90	Andavan	62	M	132875	R	3/60	MSICS	-	6/12	-
91	Kathammal	49	F	132890	L	5/60	MSICS	-	6/9	-
92	Patturoja	66	F	132895	R	2/60	MSICS	-	6/12	-
93	Gomathi	48	F	132898	L	1/60	MSICS	-	6/6	-
94	Ulaganathan	70	M	132900	R	6/36	MSICS	corneal oedema	5/60	6/36
95	Andal	46	F	132906	L	6/60	PHACO	-	-	-
96	Arasi	44	F	132910	R	2/60	MSICS	-	6/6	-
97	Rajeswari	70	F	132915	L	6/60	MSICS	-	6/9	-
98	Rajadevi	68	F	132918	R	6/60	MSICS	-	6/9	-
99	Ponnathal	64	F	132920	L	1/60	MSICS	-	6/9	-
100	Poovarasi	49	F	132930	R	2/60	MSICS	-	6/9	-

S.No : Serial Number

MASTER CHART ABBREVIATIONS

S.No. : Serial Number

I.P.No : In Patient Number

R : Right

L : Left

MSICS : Manual Small Incision Cataract Sugery

PHACO : Phacoemulsification

PCR : Posterior capsule rent

BCVA : Best Corrected visual acuity

Surgery	Frequency	Percentage (%)
Phaco	40	40
Manual Phaco	60	60
Total	100	100

I

Age (in years)	Phaco	Manual Phaco
<50		
51-60		
>61		

Age (in years)	Phaco	Manual Phaco
<50	62.5	16.7
51-60	25	50
>61	12.5	33.3

MALE	45
FEMALE	55

	PHACO
MALE	37.5
FEMALE	62.5

	MAJNUAL PHACO
MALE	50
FEMALE	50

IMPROVED	100	93.3
STAYED SAME	0	0
DETERIORATED	0	6.7

VISION	PHACO	MSICS
6/6 – 6/9		7360.00%
6/12 – 6/18	11.1	
6/24 – 6/36	0	5.55
Jun-60	0	3.33
< 6/60	0	3.33

VISION	PHACO	MSICS
6/6 – 6/9	83.3	76.6
6/12 – 6/18	5.5	16.6
6/24 – 6/36	5.5	0
	5.5	3.3
< 6/60	0	3.3

Improved	100	93.7
Stayed same	0	0
Deteriorated	0	6.3

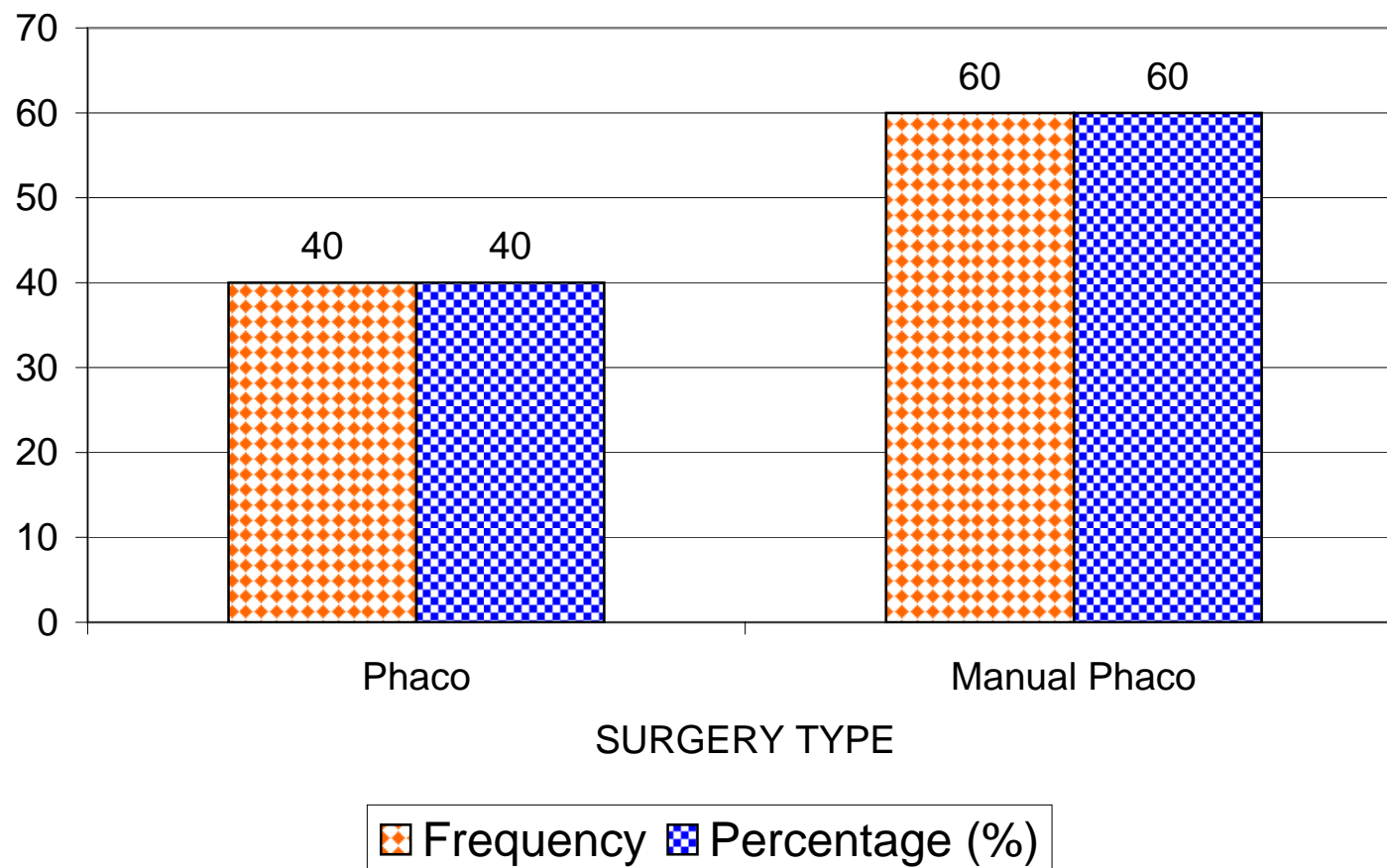
VISION		
6/6 – 6/9	85	84.4
6/12 – 6/18	10	9.4
6/24 – 6/36	5	0
	0	0
< 6/60	0	6.2

	40 DAYS	6 MONTHS
PHACO	1.1	1.11
MANUAL PHACO	1.12	1.33

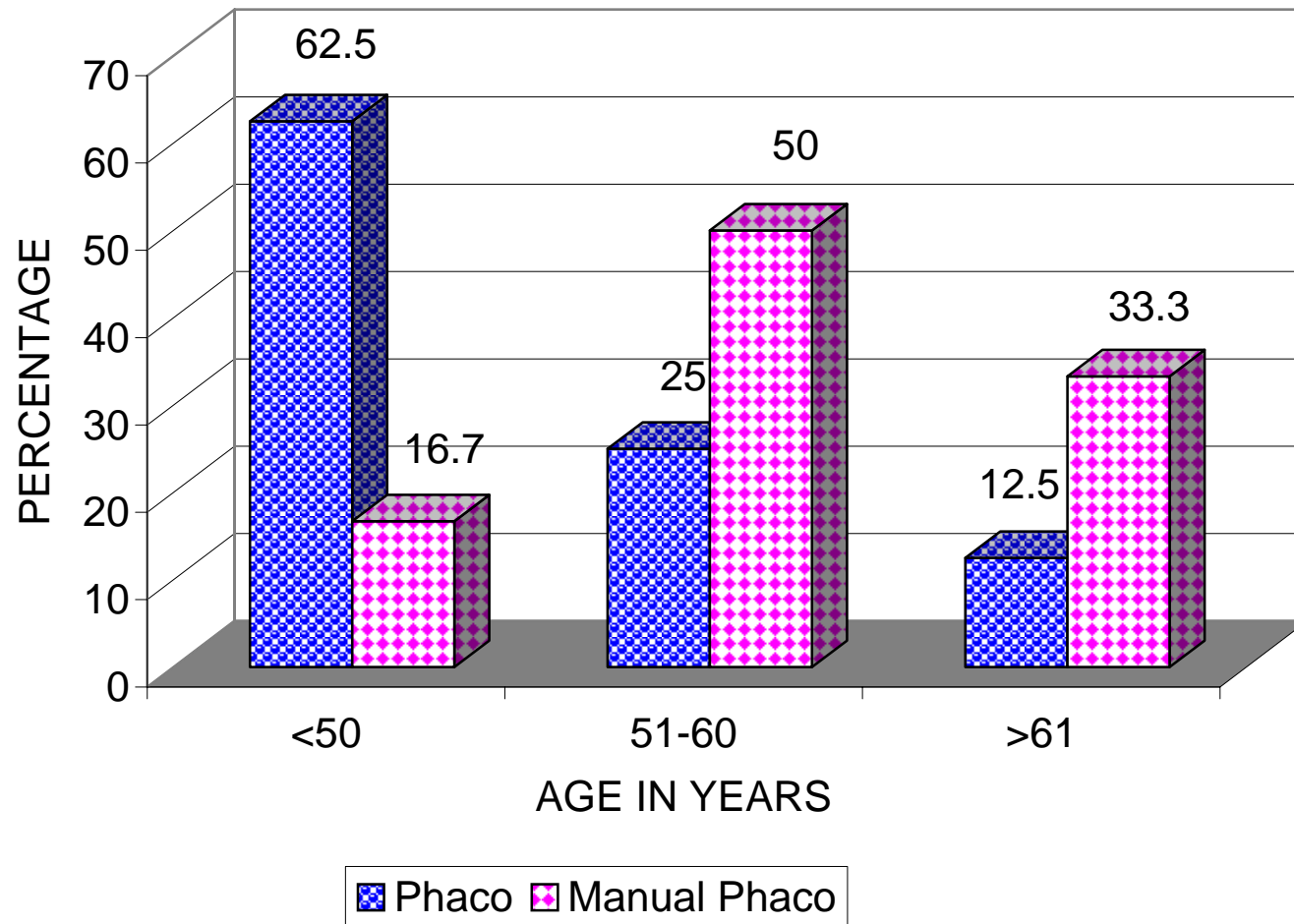
PHACO
MANUAL PHACO

4.4
10

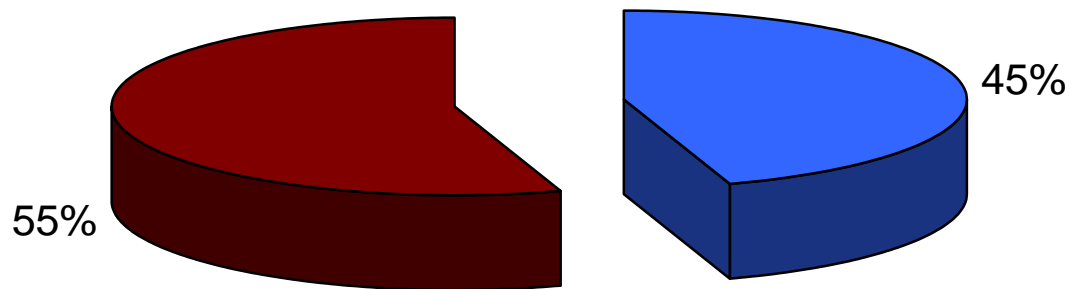
TYPES OF SURGERY



AGE INCIDENCE

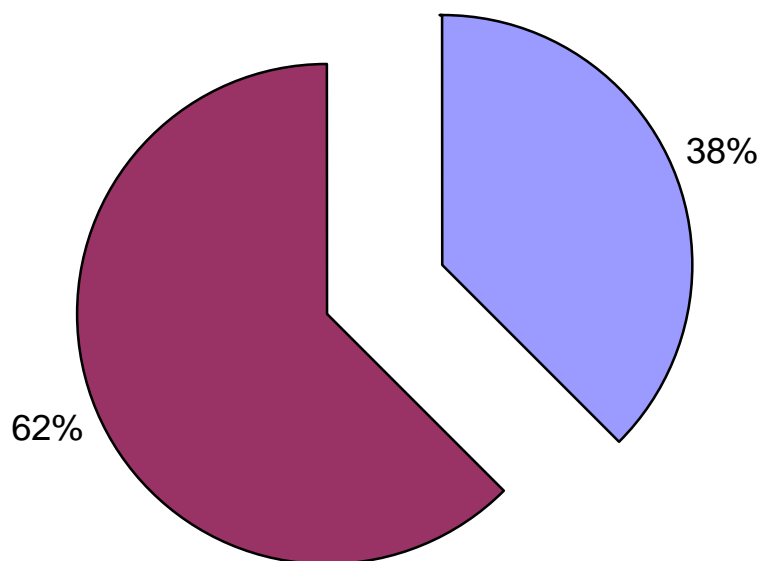


SEX INCIDENCE
TOTAL MALE AND FEMALE RATIO
(45 : 55)



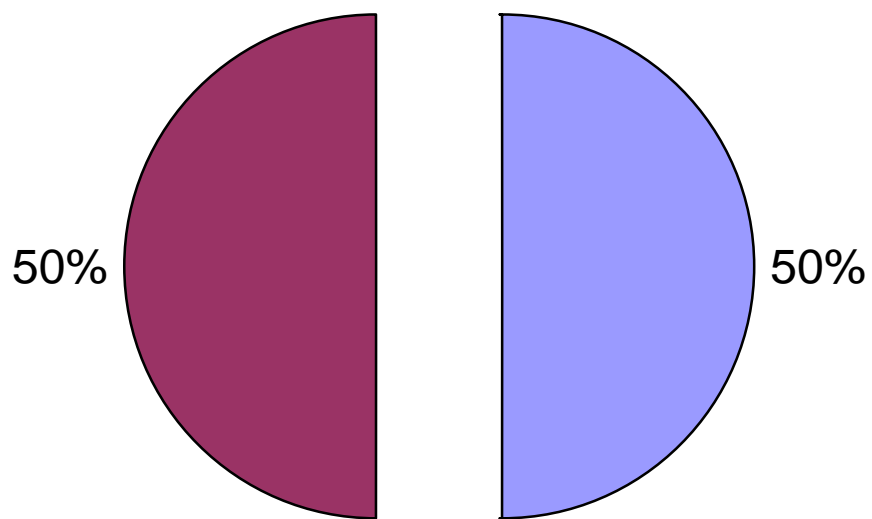
■ MALE ■ FEMALE

SEX INCIDENCE IN PHACO



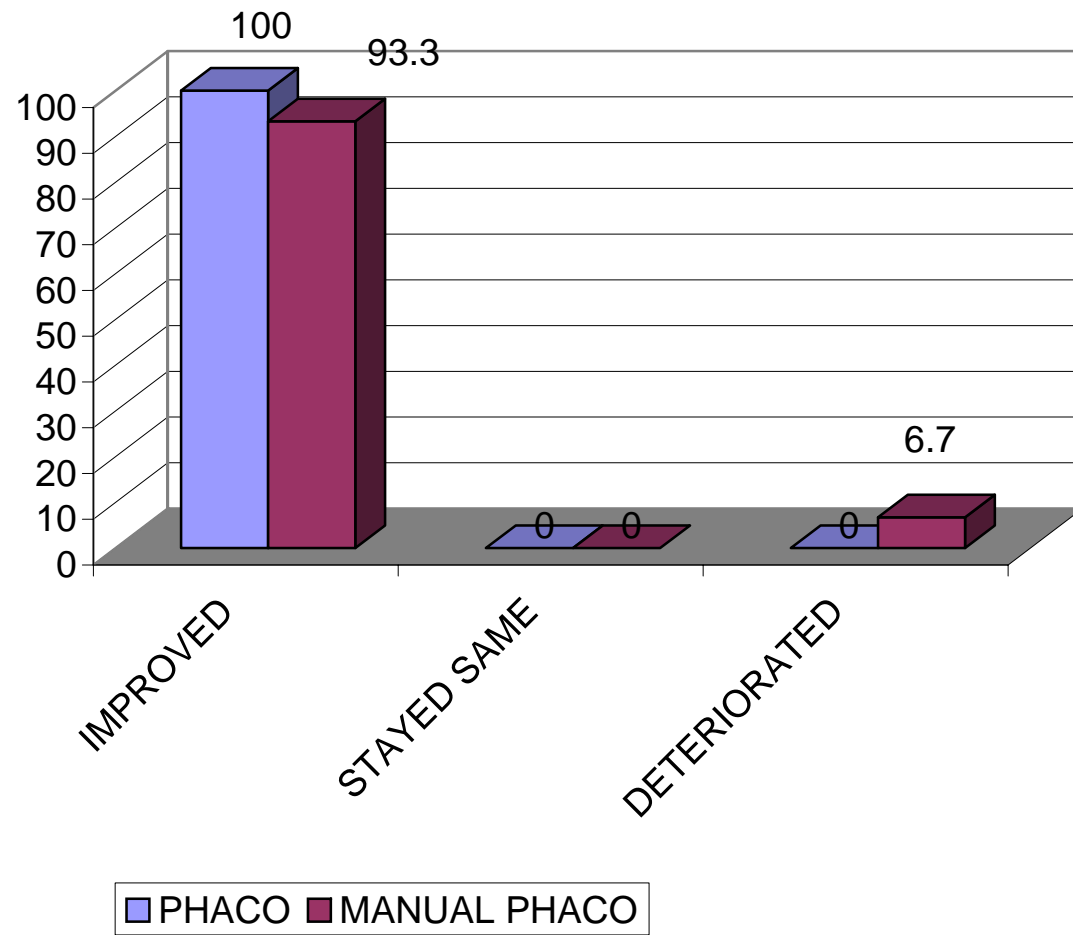
MALE FEMALE

SEX INCIDENCE IN MANUAL PHACO

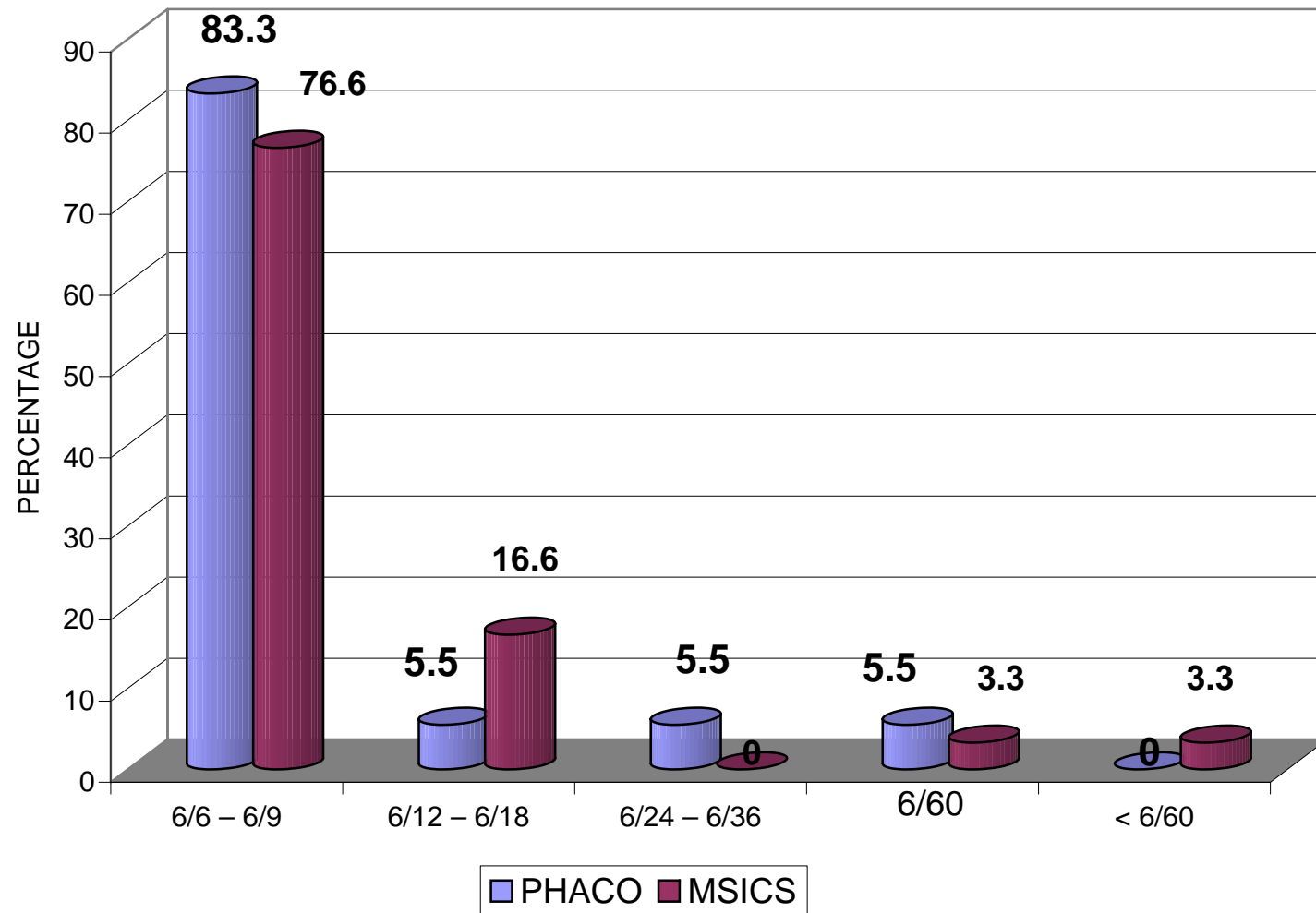


MALE FEMALE

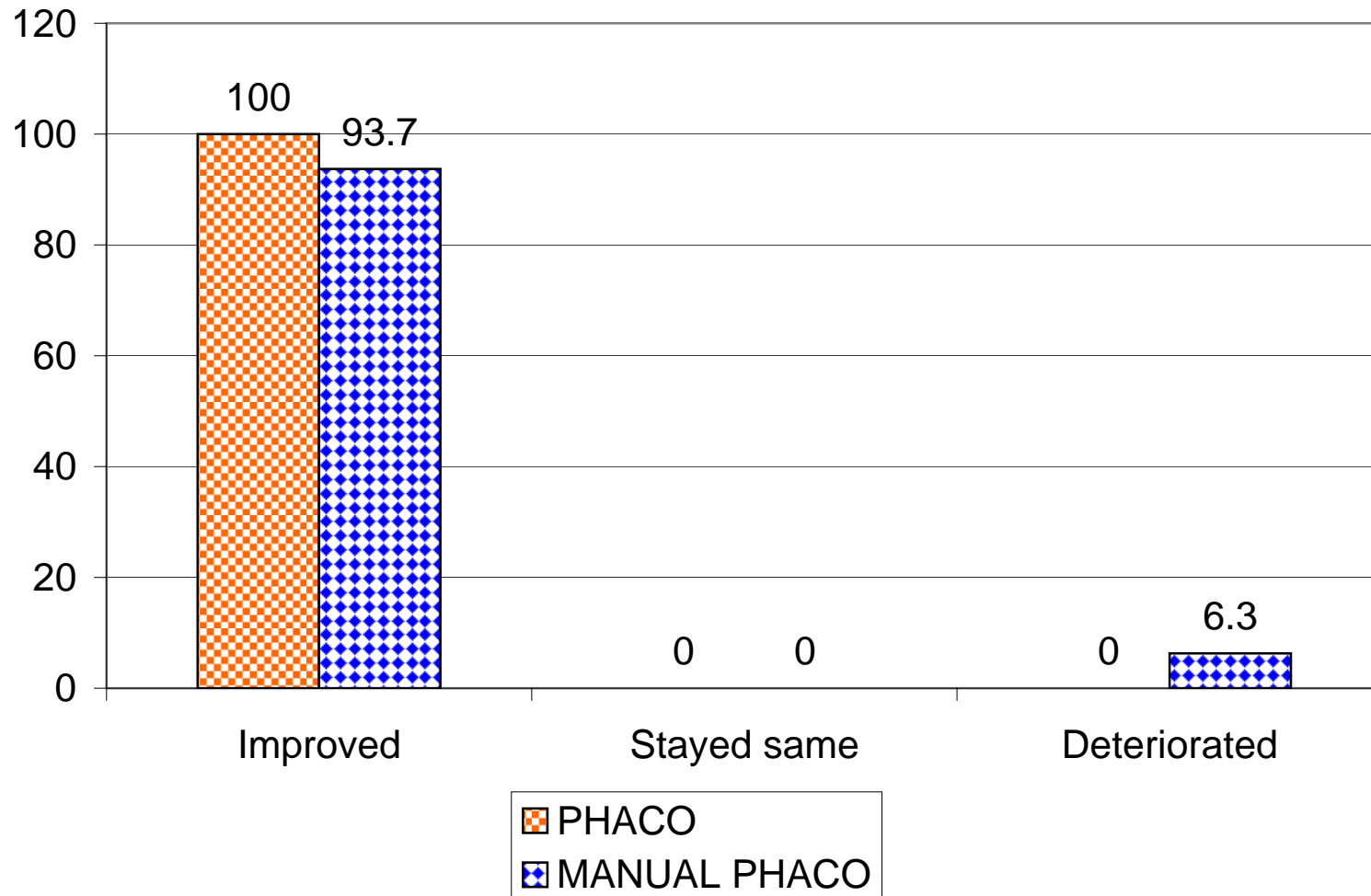
CHANGE IN VISUAL ACUITY - 40 DAYS



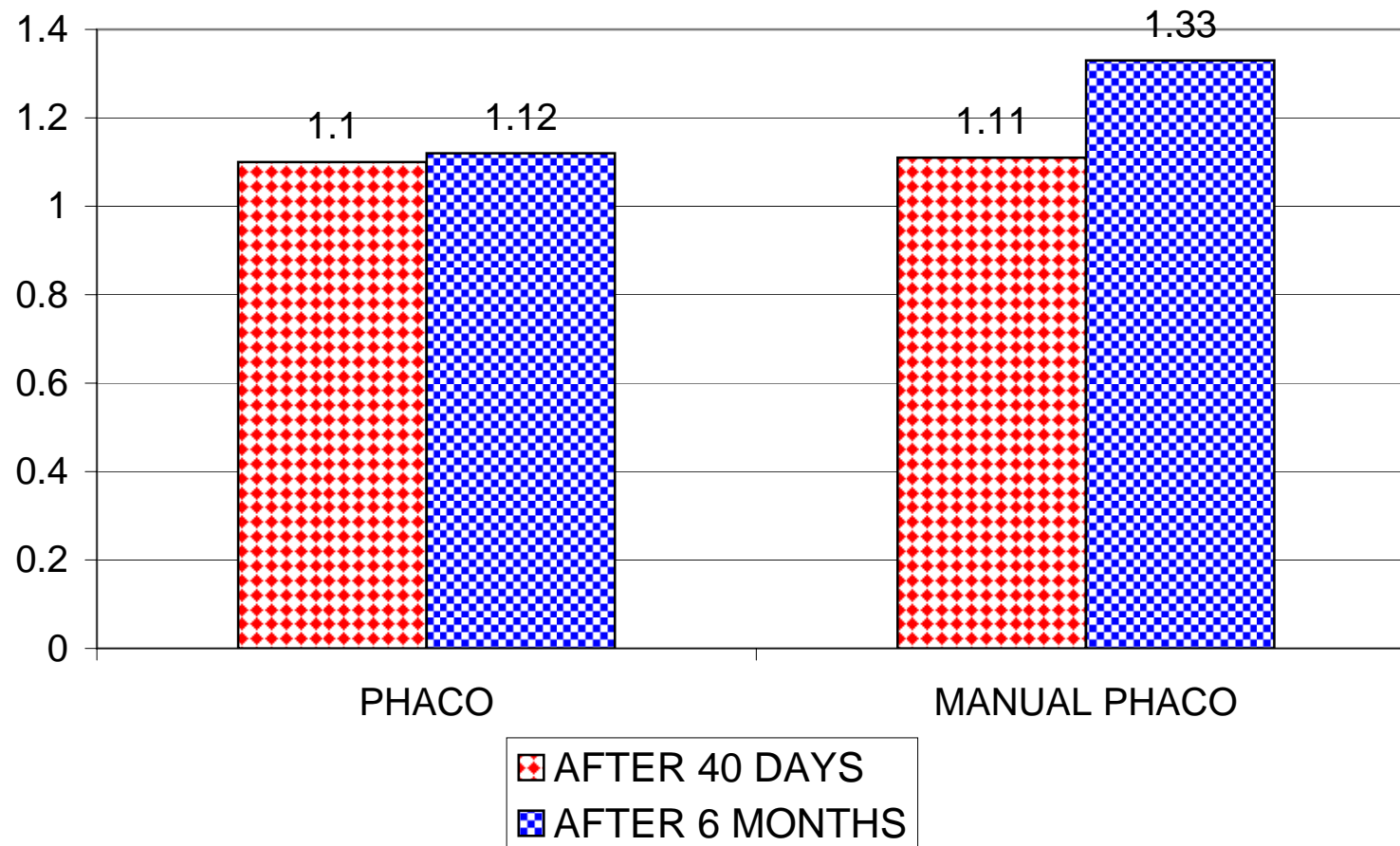
VISUAL ACUITY STATUS - 40 DAYS



CHANGE IN VISUAL ACUTIY - 6th MONTH



MEAN INDUCED ASTIGMATISM IN DIOPTRES



INTRAOPERATIVE COMPLICATIONS

